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Natural Resource Inventory Update

stream mapping project

CITY OF PORTLAND, OREGON
BUREAU OF
Planning

project description

The stream mapping project originated in 2003 as the Bureau of Planning was developing a new automated GIS model to map and rank landscape features that contribute to riparian resource values and functions. This map will be used to update Portland's significant natural resource inventories.

Initially the model was developed and tested using Metro's regional stream map layer. However, during the model testing phase it became apparent that the stream centerline locations were not accurate enough to support Portland's inventory update and resource protection program. A more detailed, precise map of streams was necessary for analysis at the local scale.

The key goals of the re-mapping project were defined as:

- to refine the location of streams previously mapped Metro;
- to verify the existence and location of a number of stream segments that were not previously mapped by Metro or included in the City's significant natural resource inventories;
- to refine the maps to address the location of piped stream segments and their connections to open channels, as there had never been a complete review of stream location and surface water piping within the City.

The stream re-mapping project has focused on streams flowing through the City of Portland, as well as those located within unincorporated parts of Multnomah County that are administered by the City of Portland. Beginning in April of 2003 the Bureau of Planning began revising stream geometry based on information from reference data sources including 2' contours, aerial photos, and GPS surveys. New streams were also added where previously unmapped surface flow was identified. All revised and new surface streams were connected to the stormwater and combined sewer/stormwater pipes as mapped by the Bureau of Environmental Services.

In addition, the Bureau of Planning conducted an extensive field effort where needed to confirm the existence and location of stream channels and piped segments. Field crews employed global positioning system (GPS) technology to verify the presence and location of streams where this information could not be derived from available sources of information. The field effort included streams on public and privately-owned land (with permission from property owners).

The stream mapping project has been a collaborative effort involving Portland's Bureaus of Planning, Parks and Recreation, Environmental Services, and Corporate GIS. Metro also participated in the project. GIS staff from each of these agencies met at the beginning of the project to share the stream centerline information used by each agency at that time. This information was combined into a single, regional stream centerline dataset that served as a

starting point for the mapping. The revised stream centerlines are provided to all City bureaus for their use, and to Metro for regional distribution along with the Regional Land Information System (RLIS) “Natural Resource” GIS data.

The following report provides a brief description of the project status, the stream mapping methodology, and the data sources used as reference for re-mapping and adding streams. For a detailed description of the stream centerline GIS data, please refer to the online metadata at: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52071&Db_type=sde&City_Only=False.

project status

The initial mapping and classification of stream centerlines has been completed. The data will be updated regularly as new information becomes available. The following chart shows how a summary of stream miles mapped as of **January 23rd, 2006**:

Stream Mapping Project Summary
Miles of streams currently mapped in Portland and the Multnomah County pockets

Re-mapping progress to date:	miles	%
Total miles of streams previously-mapped by Metro:	180	
Miles of previously-mapped streams revised:	180	100.0%
Miles of streams added:	131	
Total stream miles revised or added:	*311*	
Total number of surface stream miles revised or added:	*260*	83.6%
Total number of piped stream miles revised or added:	*51*	16.4%
Stream verification to date:		
Stream miles verified using existing sources:	250	80.4%
Stream miles verified in the field:	24	7.7%
Total stream miles verified to date:	*274*	*88.1%*
Remaining stream miles to verify:	*37*	*11.9%*
Field work summary to date:		
Total number of property owners contacted:	670	
Number of property owners granting access:	304	45.4%
Number of properties visited:	163	24.3%

methodology

The starting point for the re-mapping project was the 2003 regional stream centerlines developed by Metro. More accurate stream centerline maps available for select areas around the City were also used as reference – including Columbia Slough centerlines created by the Bureau of Environmental Services and Powell Butte centerlines mapped by the Bureau of Parks and Recreation. All editing of stream data was done in ESRI's ArcInfo workstation (ArcGIS version 8.2).

1) Stream Mapping Protocol

BES collection line GIS data, photogrammetric data (2' contours), and aerial photos were among the data sources referenced by the Bureau of Planning during re-mapping of the stream centerlines.

Streams that were previously-mapped by Metro[1] were checked against all reference sources and re-mapped starting at the lowest confluence and moving up to the headwaters. Virtually all of the previously-mapped streams were re-mapped to correspond with the new and more detailed reference data. Any new tributaries apparent in the reference data were added to the map as they were encountered during the revision process (Figure 1).

New streams were required to satisfy the following criteria in order to be added to the map:

› a channel exists and appears to formed, at least in part, by water flowing through it - flow may be comprised of water from streams, surface flow, or stormwater discharge. Channels that emerge downstream of a pipe were mapped as beginning at the pipe outlet;

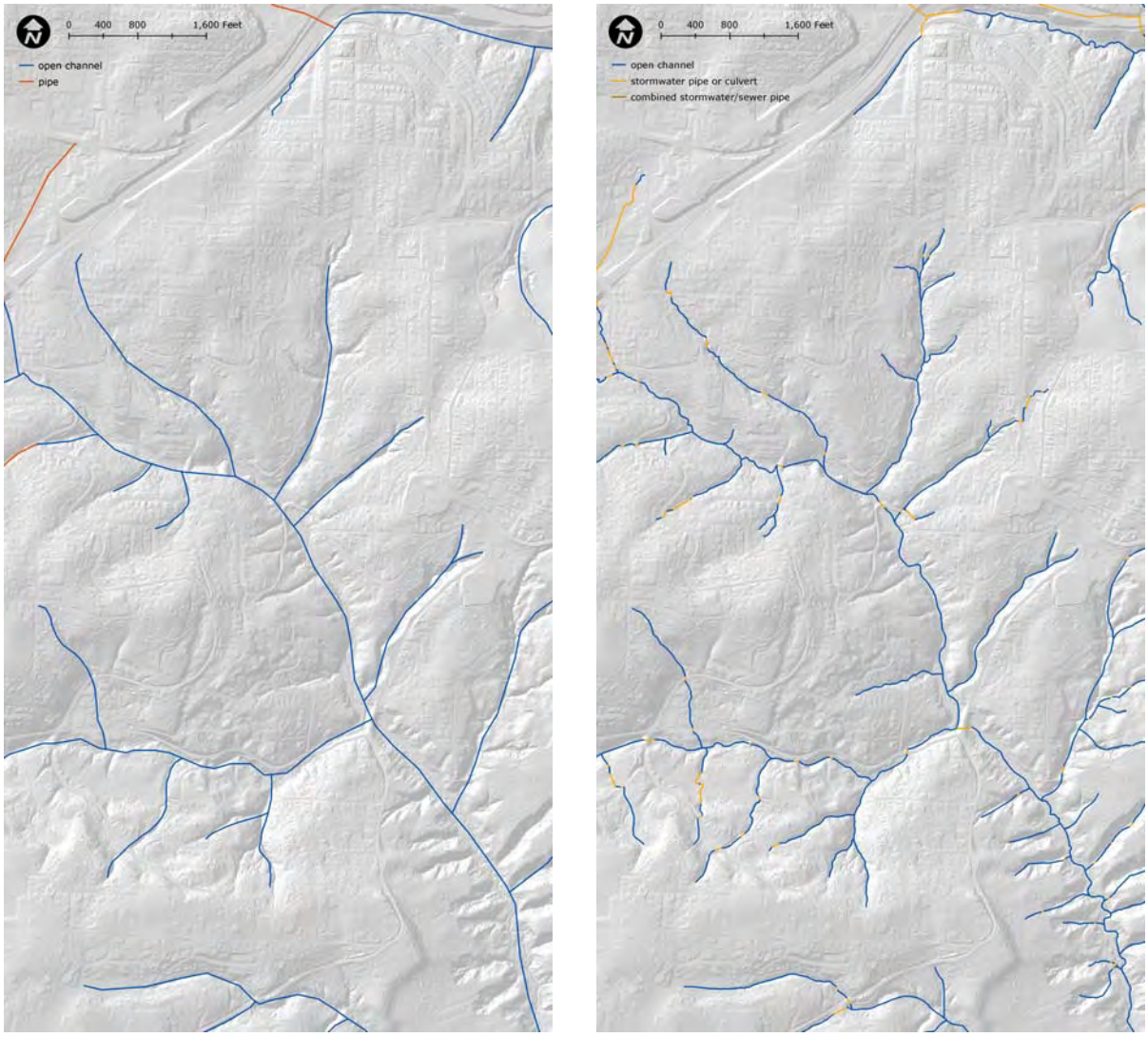
› the topographic information, aerial photo, or BES collection line information indicates that water on or upstream of the site drains to the channel;

› the length of the stream was greater than 50' (streams and springs under 50' in total length were not mapped.)

Any stream segments satisfying the mapping criteria above were further evaluated based on the following:

› If two or more reference sources affirmed the existence of a stream channel (e.g., topography indicates a channel and BES has mapped the channel), project staff deemed

[1] Metro's 2003 stream data was originally based upon 1:24000 USGS quad topography. Stream centerlines and banks were adjusted or digitized at approximately 1:10000 using the 1998 Spencer Gross 2'-resolution aerial photography.



Original Metro Centerlines

Remapped Stream Centerlines

Figure 1. Comparison of previously-mapped Metro streams and remapped stream centerlines.

the stream “substantiated” and required no further verification. The stream was mapped based on the reference data.

› If a stream channel was supported by only one reference source (e.g., topography suggests a channel), project staff “flagged” the channel for field verification .

The Bureau of Planning compiled a list of all property owners whose tax lot contained a channel flagged for field verification. Property owners were sent a letter requesting permission for City staff to enter their property for on site stream verification. The request included a self-addressed stamped return envelope for property owners to reply. Approximately 46% of property owners contacted granted access.

Database attributes from the old stream centerlines were transferred to the new stream centerlines. Additional information about the new and revised streams was also captured, including the channel type, source of the stream geometry, and the date of the modification.

2) Field Verification Methodology

Project staff visited properties owned by the public and privately-owned properties where the owner had given written permission allowing access.

Because of time and staff constraints, staff was not able to visit every property that was accessible. Priority for visitation was given to stream segments flowing through properties where a larger percentage of property owners had given staff permission to enter and survey the stream. Staff also focused on visiting streams that are relatively easy to access given topography (e.g., not steep vs. steep) and vegetation (e.g., penetrable vs. overgrown).

Once the decision to visit a particular stream segment was made, a field crew visited the site and verified the presence and location of the stream channel. Field crews used both visual assessment and, when GPS-satellite coverage was available, differentially-corrected GPS data collection. Field crews also took written notes on the location and description of the stream segment..

Field crews carried copies of a standard field visit form for notes and sketches, a map showing local topography, streams, etc., and a map with 6”-resolution aerial photographs of the property and surrounding area. All notes and maps for a particular field visit were scanned and stored in Acrobat PDF format. Digital photos of the stream were also taken in most cases. All digital documentation and photos are available from the Bureau of Planning.

Two survey-grade GPS receivers were used during the project – a Trimble Pathfinder Pro backpack system and a Trimble GeoXT handheld receiver. Both systems collected points and lines with an

average horizontal error after differential correction of between 1 and 3 feet.[2] Two types of GPS data were collected – point features and line features.

Point features represented a minimum of 10 GPS points collected at 1-second intervals at multiple locations along a stream channel. GPS points at each location on the stream were differentially-corrected, averaged, and exported to GIS shapefile format. Stream centerline segments were then digitized by manually "connecting" the field collected points in ArcInfo workstation. Digitized lines were "smoothed" to more realistically portray stream geometry. Most GPS data was collected as point features.

Line features were created by collecting a series of points at 1-second intervals while physically walking the centerline of a stream. The collected points were each differentially-corrected and exported to GIS shapefile format as the vertices of a line feature. The advantage of this method was that it produced an actual centerline that could be directly incorporated into the stream dataset, rather than a series of points that had to be manually connected. However, because the points were not averaged at a single location over time, this method was slightly less accurate then the point feature collection method. In addition, it was only practical when the stream channel was open enough to allow relatively long – 50' or more – sections to be walked without obstruction.

A summary of the specific GPS data collection parameters follows:

- Collection interval: 1 second
- Minimum number of points[3]: 10
- Maximum PDOP[4]: 6
- Minimum number of satellites: 4
- Elevation mask: 15º above the horizon

Points were differentially-corrected using the base station located at the U.S. Forest Service/Bureau of Land Management building in downtown Portland[5]. All GPS data was exported into the U.S. Stateplane coordinate system, in international feet, based on the NAD HARN/HPGN datum.[6] All GPS point and line features collected for the stream re-mapping project are available in ESRI Shapefile format from the City of Portland, Bureau of Planning.

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[2] Differential correction is the process of correcting GPS data collected on a field unit with data collected simultaneously at a fixed base station. Because the base station it is at a known, surveyed location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the field collected data.

[3] Though a minimum of 10 GPS points were required, field crews attempted to collect a minimum of 60 points (1 minute of data collection) whenever possible.

[4] The Position Dilution of Precision (PDOP) is a numerical value representing the quality of the satellite geometry and its impact on data collection accuracy.

[5] refer to http://www.fs.fed.us/database/gps/portland.htm for more information about the U.S. Forest Service base station.

[6] High Accuracy Reference Network (HARN) datum, a.k.a. High Precision GPS Network (HPGN), is a statewide upgrade to the NAD83 datum using Global Positioning System (GPS) observations.

Streams flagged for further verification and visited in the field were remapped to correspond with the visual assessment and/or GPS information collected for that segment. Streams located in this matter were assigned a “field date” in the stream centerline GIS database. Not all streams flagged for field verification were visited by project staff. To date, approximately 40% of flagged streams have been visited. Any flagged streams not visited are identified in the stream centerline GIS database.

reference data sources

The following sources were used as reference for determining the presence and/or location of stream centerlines:

Source:	**BES Collection Lines**
Created By:	City of Portland, Bureau of Environmental Services
Data Format:	GIS Shapefile
Date of Last Update:	11/26/2003
Description:	City of Portland regional sewer and drainage infrastructure. Includes sewer lines, stormwater pipes, combined sewer/stormwater pipes, culverts, and drainage ditches.
Notes:	Data is viewable for specific properties via www.portlandmaps.com
Metadata Reference:	http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52073&Db_type=sde&City_Only=False

Source:	**Photogrammetric Data (2' Contours)**
Created By:	City of Portland, Bureau of Environmental Services.
Data Format:	GIS Shapefile
Date of Acquisition:	1988 to 1994 (depending on location)
Description:	City of Portland 2' elevation contours. Contour lines derived from stereo analysis of aerial photos flown between 1987 and 1994. Created for the Bureau of Environmental Services. Not registered directly to the Taxlot base maps. Topographic lines have breaks where building or other cultural features exist.
Notes:	Data is viewable for specific properties via www.portlandmaps.com
Metadata Reference:	http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52452&Db_type=sde&City_Only=False

Source:	**1998 – 2004 Aerial Photos**
Created By:	Varies; refer to metadata
Data Format:	Geo-referenced TIFF images
Date of Acquisition:	2004 aerials – July 21, 22, 24, 2004 2003 aerials – July 18, 19, 2003 2002 aerials - August 2002 2001 aerials - July 23, 25, 26, 2001

	2000 aerials – June 28, 29, July 7, 15, 2000 1998 aerials – July 1998
Description:	Natural color ortho-rectified digital imagery. All photography has been rectified to adjust for curvature of the earth. Photo resolution for all years except 2001 is 6"; 2001 photo resolution is 1'.
Notes:	Data is viewable for specific properties via www.portlandmaps.com
Metadata Reference:	http://geode.metro-region.org/metadata/index.cfm?startpage=main.cfm?db_type=rlis (listed by aerial year)

Source:	**2004 LiDAR Data**
Created By:	Puget Sound LiDAR Consortium
Data Format:	ERDAS Imagine Image
Date of Acquisition:	March 2004
Description:	LiDAR elevation information collected in March of 2004 for the Tryon Creek Watershed area. Bare-earth return points rasterized into a 3' digital elevation model (DEM). DEM was used to generate hillshades and 2'/5'/10' contours that were used to map streams.
Notes:	Data is the property of the City of Portland, Bureau of Environmental Services.
Metadata Reference:	\\Cassio\gis_ms\LIDAR\PROCESSED_Data\tryon_lidar_bareearth_3ft_METADATA.htm (metadata available to City of Portland employees only. Can be made available to outside parties upon request.)

Source:	**5' Elevation Contours**
Created By:	Metro
Data Format:	GIS shapefile
Date of Acquisition:	July 2001
Description:	Five-foot elevation contours for urban areas of Multnomah, Clackamas, and Washington counties. Created as a by-product of the 2001 digital ortho-rectified imagery. Covers Portland metropolitan area.
Notes:	Copyright 2001 by Metro.
Metadata Reference:	http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52453&Db_type=sde&City_Only=False

Source:	**BES Slough Centerlines**
Created By:	City of Portland, Bureau of Environmental Services

Data Format:	GIS Shapefile
Date of Last Update:	11/26/2003
Description:	Stream centerlines mapped by the Bureau of Environmental Services Columbia Slough watershed team. Stream locations not field verified.
Notes:	Shapefile data for the entire Columbia Slough watershed is available from BES.
Metadata Reference:	None currently available – contact Kevin Ramey in the City of Portland, Bureau of Environmental Services for more information.

project contacts

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